UV/EB CURABLE RESINS

Dual Cure Product Guide - Automotive Interior - Worldwide

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Facts & Figures

- Global company with over €2.1 billion in sales
- Broad technology portfolio: liquid coating resins, energy curable resins, powder coating resins, crosslinkers and additives, composites and construction materials
- Approximately 4000 employees
- Customers in more than 100 countries
- 33 manufacturing facilities
- 23 research and technology centers
- 5 ventures
- Extensive range of solutions for key coating segments: automotive, industrial, packaging coating and inks, protective, industrial plastics and specialty architectural

With manufacturing, R&D and technical facilities located throughout Europe, North America, Asia Pacific and Latin America, allnex offers global and reliable supply of resins and additives combined with local, responsive customer support.

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Introduction

UV/EB Curable Resins (Radcure)
Ultraviolet (UV) and electron beam (EB) energy-cured coatings have excellent appearance, durability, and little or no VOC emissions, while enabling increased productivity and lower overall costs per cured part.
allnex is the pioneer in UV resin / Radcure technology and applications development. We are the world's leading producer of energy-curable resins for the industrial and plastic coatings as well as the packaging coatings and inks applications, driving market growth and end-user acceptance of this unique technology.

Our customers have come to rely on our broad range of innovative EBECRYL® and UCECOAT® resins including:
- 100% solids UV curable resins and oligomers
- Waterborne UV curable resins
- UV curable resins derived from renewable raw materials
- A wide range of urethane acrylates, polyester acrylates, amino acrylates and epoxy acrylates
- Specially-designed photo initiators and additives that enhance the performance of energy-cured coatings.

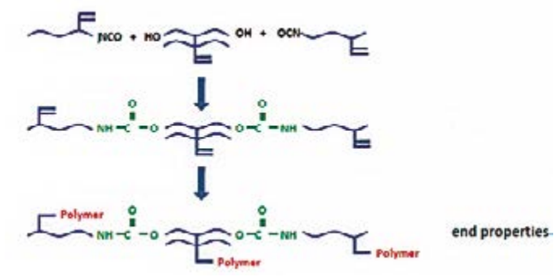
UV Curing for Automotive Applications
With the proliferation of plastics in automotive interior applications and ever more stringent OEM requirements, automakers and tiered suppliers are turning to energy-curable coatings that are the only technology currently available that offers performance, robustness, specific haptic and aesthetic effects, as well as improved productivity, durability, and chemical resistance.

- **PERFORMANCE**: coating suppliers will be able to achieve good weathering and great scratch, abrasion, stain, and chemical resistance, compared to those achieved with other coating technologies.
- **PRODUCTIVITY**: the almost instantaneous cure brought by UV/EB technology allows for increased efficiency and better productivity, which in turn reduce manufacturing costs and coating rejects.
- **SUSTAINABILITY**: substantial energy savings can be achieved thanks to faster curing time, and there is little to no Volatile Organic Compounds (VOC) emissions. On top of this, using plastics in automotive interior also helps lower the overall weight of the vehicle, resulting in a lower carbon footprint, improved energy and fossil fuel consumption, and much reduced CO2 emissions.
- **VERSATILITY**: Due to the low heat impact of the coating process, UV/EB coatings can be applied to a host of thin, pliable, or heat sensitive plastic substrates and formulated to have direct adhesion thus eliminating the need for primer.

Applications

Dual cure technology

The significant advantage of dual cure systems is that thermal curing can help when curing non-planar parts, while UV curing provides excellent scratch and chemical resistance, as well as short curing times which help to minimize dirt on the parts' surface. It should be noted that UV curing of non-planar (3D) parts is known to be challenging from an equipment perspective, as the curing layout needs to be custom-made when dealing with very complex 3D structures. This makes dual cure technology all the more valuable in the market. The combination of hydroxy functional acrylates with isocyanate (NCO)-bearing acrylates allows formulators to have the best of both worlds (thermal and energy-curable kinetics)*. The implementation of such an additional reaction can create a coating with improved weatherability and similar hardness to a traditional hardcoat, but at a lower acrylate crosslinking density with greater ductility. Another benefit of employing this chemistry is overcoming the line of sight limitations (shadow cure) with energy-curable chemistry because coatings not exposed to the UV light do not cure. In this case, crosslinking can take place through a two-component curing process. Dual cure technology also offers process improvements typically not seen with UV/EB coatings. After the thermal process, dual cure coatings can be tack-free and non-blocking. At this particular stage, the coated substrates can be formed, cut, or molded into a variety of shapes or sizes prior to exposure to UV light.



* SB UV 2K Principle (OH acrylate -NCO reaction)

Dual cure technology can be used in two main applications when it comes to automotive interior.

- **Automotive Interior Spray** (consoles, dashboards, seats, door panels, instrument panels and more)



- **Automotive Interior Film** (IMD, thermoforming of parts)


Performance Keys

	●	●	●●	●●●	●●●●	●●●●●
Reactivity		Poor	Good	Very good	Excellent	Outstanding
Hardness		Poor	Good	Very good	Excellent	Outstanding
Flexibility		Poor	Good	Very good	Excellent	Outstanding
Chemical resistance		Poor	Good	Very good	Excellent	Outstanding
Adhesion		Poor	Good	Very good	Excellent	Outstanding

Definitions

Color	Maximum values in: • Gardner scale when no units are specified – range from light yellow to red defined by the chromaticities of glass standards numbered from 1 for the lightest to 18 for the darkest • Pt/Co or APHA-Hazen (A) scale – defined by specified dilutions of a platinum-cobalt stock solution, ranging from 1 at the light end of the scale to 500 at the darkest • Iodine scale - defined by specified dilutions of an iodine solution, ranging from 1 for the lightest colour to 500 for the darkest
Density	Expressed in g/cm³
Dilution	Parts of diluent in 100 parts of product
Functionality	Theoretical value, expressed as number of double bonds per molecule
Molecular weight (Mn)	Theoretical molecular weight
Viscosity	Viscosity in milliPascal-seconds (mPa•s) at the specified temperature. Note: mPa•s = centiPoise (cP)

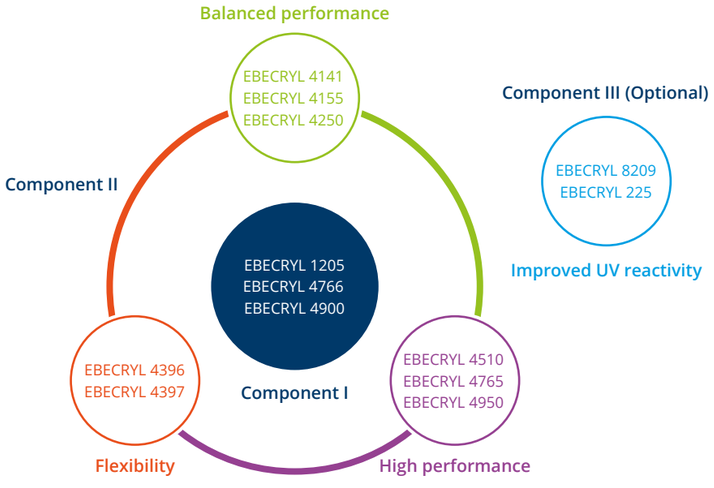
Abbreviations

EtAc	Ethyl acetate
BuAc	Butyl acetate

Urethane acrylates for Dual Cure

Products	Description	Dilution	Viscosity at 25°C approx. mPas	NCO content % on supply form	OH value mg KOH/g on supply form	Molecular Weight (Mn)	Properties	Reactivity	Hardness	Flexibility	Chemical resistance	Adhesion
Component I												
EBECRYL® 1205 (Sn)	Acrylic acrylate (tack-free before UV cure)	48 BuAC	1000		75		Low yellowing, excellent humidity resistance & adhesion to plastics	●●●	●●●	●●●	●●●●●	●●●●●
EBECRYL 4766	Polyester methacrylate		3000		170		High gloss potential, improve flexibility & outdoor durability					
EBECRYL 4900 (Sn)	Aliphatic urethane acrylate	40 BuAc	1500		28		Physically drying. Excellent chemical resistance. Suitable for deep draw thermoformable coatings with high elongation properties after thermal curing.	●●	●●	●●●	●●●●●	●●●●●
Component II												
EBECRYL 4141 (Sn)	Aliphatic urethane acrylate		10000	12		700	Adhesion promoting resin, balanced properties.	●●	●●●●	●●	●●●●	●●●
EBECRYL 4155	Aliphatic urethane acrylate		5500	9			Flexible. Low viscosity for higher solid formulation.	●	●●	●●●●	●●●	●●●●●
EBECRYL 4250 (Sn)	Aliphatic urethane acrylate		2000	5		1100	Good balance hardness-flexibility, high UV-reactivity.	●●●	●●	●●●	●●	●●●●
EBECRYL 4396	Aliphatic urethane acrylate		14000	7.5		1200	Flexible, improve adhesion.	●	●●	●●●●	●●●	●●●●
EBECRYL 4397	Aliphatic urethane acrylate		12000	6.8		1400	Low Tg and high flexibility, excellent adhesion and humidity resistance.	●	●●	●●●●●	●●●	●●●●●
EBECRYL 4510 (Sn)	Aliphatic urethane acrylate	10 BuAc	17000	7		1200	Hard, good abrasion resistant, good adhesion, high UV reactivity.	●●●●	●●●●	●●	●●●●	●●●●
EBECRYL 4765 (Sn)	Aliphatic urethane acrylate	45 EtAc	125	4.3		2300	Hard, good abrasion resistant, high UV reactivity.	●●●	●●●●	●●	●●●●	●●●
EBECRYL 4950 (Sn)	Aliphatic urethane acrylate	20 BuAc	1700	6,2			Good hardness, high reactivity, scratch and stain resistances, good abrasion resistance.	●●●●	●●●●	●	●●●●	●●●
Component III												
EBECRYL 8209 (Sn)	Aliphatic urethane acrylate		4000			600	OH-functionalized urethane acrylate for dual cure application.	●●●●	●●●●	●	●●●●	●
EBECRYL 225	Aliphatic urethane acrylate		75500			1200	Good reactivity. Excellent hardness and outstanding scratch resistance.	●●●●	●●●●	●	●●●●	●●

(Sn) Sn-free *EBECRYL UV curable resins and diluting oligomers



Dual Cure product matrix

Products	Regional Availability NORTH AMERICA	EMEA	CHINA	JAPAN	SOUTH KOREA	TAIWAN
Component I						
EBECRYL® 1205	Yes	Yes	Yes			
EBECRYL 4766	Yes	Yes	No	No	No	No
EBECRYL 4900	Yes	Yes	Yes	Yes	Yes	Yes
Component II						
EBECRYL 4141	Not yet on TSCA	Yes	Yes, for specific allnex notification units	Yes		
EBECRYL 4155	Yes	Yes	Yes, for specific allnex notification units	Yes	Yes	Yes
EBECRYL 4250	Yes	Yes	Yes, for specific allnex notification units	Yes		Yes
EBECRYL 4396	Yes	Yes	Yes	Yes		Yes
EBECRYL 4397	Yes	Yes	No, but OK for specific notification units	Yes		
EBECRYL 4510	Yes	Yes	Yes	Yes	Yes	Yes
EBECRYL 4765		Yes	No, but OK for specific notification units	No, but OK for specific notification units		
EBECRYL 4950	Yes	Yes	Yes, for specific allnex notification units	Yes	No, but OK for specific notification units	Yes
Component III						
EBECRYL 8209	Yes	Yes	Yes	Yes		Yes
EBECRYL 225	Yes	Yes	Yes	Yes		Yes

Testing Specifications & Typical Substrates

VW testing specifications are broadly used as performance benchmark when it comes to OEM testing methods for automotive interior applications.

Testing specification	Criteria
Cross hatch adhesion (CHA)	0 = no adhesion; 5 = full adhesion
Erichsen scratch/adhesion (PEN 318)	20 N
Abrasion resistance (Taber haze - CS10F 500g)	Haziness value: the lower, the better
Sun lotion (VW PV3964: 24 hours at 80°C)	• CHA = 5 • Erichsen = 20 N • Appearance (film attacked: yes or no) • Gloss retention
Hand cream (VW PV3964: 24 hours at 80°C)	• CHA = 5 • Erichsen = 20 N • Appearance (film attacked: yes or no) • Gloss retention
Humidity resistance (VW TL 226: 72h at 90°C and 95 % RH)	• CHA = 5 • Appearance (no haze)

Type of substrate	Grade
ABS	• ABS Magnum 3616
ABS/PC	• Bayblend T65 • Bayblend T65XF • Bayblend T85 • Bayblend T85XF
PC	• Lexan 9030 • Lexan 8010 sheet

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